

## Claims

I claim:

- 1 1. A method for identifying moving objects in a video comprising:
  - 2 segmenting the video into a plurality of volumes;
  - 3 extracting a plurality of masks from the video; and
  - 4 applying the plurality of masks to the plurality of volumes to identify
  - 5 volumes corresponding to moving objects.
- 1 2. The method of claim 1 wherein the video includes a plurality of frames and each
  - 2 frame includes a plurality of pixels, further comprising:
  - 3 constructing a spatiotemporal data structure from the pixels of the frames,
  - 4 wherein each element in the data structure is a vector that includes color values of
  - 5 a pixel  $(x, y, t)$ , where  $(x, y)$  are coordinates of the pixel in a particular frame  $t$  in the
  - 6 video;
  - 7 selecting a vector with a minimum color gradient magnitude as a marker;
  - 8 growing an unrefined around each marker;
  - 9 removing the unrefined volume from the data structure; and
  - 10 repeated the selecting, growing, and removing steps until the data structure
  - 11 is empty.
- 1 3. The method of claim 2 further comprising:
  - 2 merging unrefined volumes that do not satisfy a minimum size requirement
  - 3 with a closest larger volume.

1 4. The method of claim 2 wherein the color gradient magnitude  $|\nabla S|$  is determined  
2 by:

$$\begin{aligned} 3 \quad |\nabla S(x, y, t)| = & |w_y(x^-, y, t) - w_y(x^+, y, t)| + |w_u(x, y^-, t) - w_u(x, y^+, t)| \\ 4 \quad & + |w_v(x, y, t^-) - w_v(x, y, t^+)|, \end{aligned}$$

5 where  $( )^-$  and  $( )^+$  represent equal distances from a central pixel in a local  
6 neighborhood of pixels.

1 5. The method of claim 1, further comprising:

- 2 determining distances between a pixel in a window of a current frame and
- 3 pixels in a window in an adjacent frame;
- 4 selecting a minimum distance of the distances as a score of each pixel in the
- 5 window in adjacent frame;
- 6 averaging the scores; and
- 7 thresholding the scores to produce the masks.

1 6. The method of claim 1, further comprising:

- 2 using frame differences as change detection masks.

1 7. The method of claim 1, wherein the step of applying the plurality of masks to  
2 the plurality of volumes to identify moving objects further comprises:

- 3 counting the number of changed pixels in portions of the masks that intersect
- 4 each volume; and
- 5 selecting volumes having counts exceeding a predetermined threshold as
- 6 moving objects.

- 1 8. The method of claim 6, further comprising:
- 2 normalizing the total counts.